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PRELIMINARY EVALUATION OF THE EFFECTS OF FELLING A BUFFER STRIP ON SOUTHERN PINE BEETLE INFESTATION BREAKOUT AND PROLIFERATION

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U. S. DEPARTMENT OF AGRICULTURE -- FOREST SERVICE
SOUTHEASTERN AREA, STATE AND PRIVATE FORESTRY
RESOURCE PROTECTION UNIT, FOREST INSECT AND DISEASE MANAGEMENT GROUP

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by

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INTRODUCTION

This evaluation seeks to utilize aspects of southern pine beetle (SPB), Dendroctonus frontalis Zimmerman, biology and behavior in the design of a SPB-associated tree mortality reduction technique. Investigations by Gara (1967), Gara and Coster (1968), and Hedden and Billings (1977) provide the rationale supporting the present evaluation.

Gara (1967), in his studies on the spread and collapse of SPB infestations, concluded that during the summer months (May-July) populations remained in the vicinity of the brood trees and were instrumental in the expansion of the infestations. This spot expansion could only occur when beetle emergence coincided with the presence of attractants being produced by beetles attacking adjacent trees (Gara 1967).

Gara and Coster (1968) in their studies on the sequence of tree infestation concluded that new attacks shifted from the initial source to an adjacent, previously unattacked stem, singly, tree by tree. Further, the distance over which this "switching phenomenon" could occur was limited. They suggested that where average tree spacing was greater than 20 to 25 feet, the expansion of an infestation was unlikely.

Hedden and Billings (1977) observed a seasonal variation in fat content of adult southern pine beetles. Fat content was observed to be highest during the fall and spring, and lowest during late summer (July-August), and midwinter (January). Although the exact significance of this variation was not investigated, Hedden and Billings suggested there was a possible relationship to observations made by Atkins (1966) on Douglas-fir beetles, D. pseudotsugae Hopk. Atkins showed that fat content of Douglas-fir beetles was directly related to host finding behavior and dispersal ability.

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The conclusions put forth in the above investigations support the primary hypotheses of the present evaluation: 1) In a southern pine beetle infestation, removal of the physical stimulus (adjacent unattacked pine trees) for continued attack at certain times of the year will result in spot disruption, 2) Once the stimulus for continued attack is removed, emerging southern pine beetles will be forced (theoretically) to disperse, 3) Forced dispersal under conditions that are physiologically unfavorable for beetle dispersal will result in a general disorientation of beetle populations and consequent reduction in successful mass attacks; i.e., mass aggregation should not occur.

The above hypotheses are similar to these supporting the cut-and-leave technique. Present knowledge (Hertel et al. 1977; Hodges and Thatcher 1976) indicates that the effectiveness of cut-and-leave lies principally in disrupting spot growth rather than in beetle mortality.

OBJECTIVES

To test a southern pine beetle spot disruption technique which is both operational and economical to implement in SPB infestations where management objectives or the nature of the area prohibit the use of salvage removal, pile and burn, or chemical treatment. By spot disruption, it is meant that the treatment technique would primarily stop spot growth, and secondarily, reduce SPB-associated tree mortality within an infestation area.

Felling unattacked pine trees immediately adjacent to the most recently attacked trees is the treatment.

TEST LOCATION AND PROCEDURES

Seven active SPB infestations were selected for evaluation during July 1977 (Table 1). All infestations were located on the Bienville National Forest in central Mississippi.

The selected spots ranged between 9 and 16 infested trees per spot and were located in immature loblolly pine stands (40 - 54 year olds). Diameter of infested trees at breast height averaged 10.4 inches. Since the infestations were similar in size and stand conditions, four were randomly selected to receive treatment, and three were assigned to be untreated checks.

The four infestations were treated on July 28 by felling unattacked pines within 30 feet of any infested pine. This procedure produced what is termed a "buffer strip" between infested trees and the surrounding forest stand. An attempt was made to fell the pines back towards the infestations, but this was not always possible.

Table 1. Southern pine beetle infestations on the Bienville National Forest selected for spot disruption evaluation.

	Infestation Number	No. of trees infested at initial visit	No. of trees vacated at initial visit	Average DBH (in.) infested	Pine basal area per acre at infested portion	Pine basal area per acre adjacent to active	Forest Type	Stand condition	Stand age (years)
Untreated	1	14	39	9	130	100	Lob.	Imm. St.	40
	2	12	4	9	110	110	Lob.	Imm. St.	54
	3	15	5	12	90	80	Lob.	Imm. St.	47
Treated	4	9	3	9	110	90	Sl.	Imm. St.	47
	5	16	9	12	50	50	Lob.	Imm. St.	41
	6	12	5	9	80	70	Lob.	Imm. St.	40
	7	12	4	12	130	50	Lob.	Imm. St.	45

At the time of treatment, all actively infested pines within all the study areas were tagged. This allowed additional SPB caused mortality after treatment, or in the untreated check spots, to be identified. A one-quarter mile radius circle around each infestations was traversed to identify any SPB-infested trees present at the initiation of the study.

At 4-week intervals after the initiation of the study, the infestations were visited to identify additionally infested trees (spot growth). During September 1977, aerial photographs were taken (1:3000) of each infestation to identify proliferation related to treatment. For purposes of this study, proliferation related to the treatment is defined as new infestations appearing within one-half mile of the study infestations.

In January 1978, the areas were again aerially photographed (1:6000) to identify spot proliferation.

Data was analyzed by testing the hypothesis that the treatment effects are equal to no treatment. Analysis was performed through use of the the t-statistic (Appendix I).

RESULTS AND DISCUSSION

Table 2 summarizes the results of the evaluation. Additional SPB related mortality within the treated spots (spot breakout) did not occur after felling the buffer strip. Spot growth continued to occur, though to a limited extent, in the untreated spots. Proliferation attributable to felling the buffer strip was evident by the appearance of only one spot around one of the treatment areas. Two of the three untreated spots, however, had proliferation occur around them. Proliferation related to treatment or non-treatment is difficult to assess since, in this case, beetle source is not definitely known.

Felling a buffer strip around an active SPB infestation as applied appears to disrupt spot growth, and does not appear to promote spot proliferation. However, the evaluated infestations were relatively small in which spot growth was limited, even when no treatment was applied. When total volumes lost, including that in the treatment buffer strip (Fig. 1), are compared, there is no significant difference in mean volume loss between treated and untreated spots (Table 2). Average total volume loss for untreated spots was 235 CF per spot, while in treated spots average total volume loss was 383 CF per spot. In performing a difference of means test, the t-statistic has a value of .84. This value is not significant at the .10 level. The details of the computation appear in Appendix I.

Table 2. Comparison of the effects on SPB spot growth and proliferation of felling a buffer strip and untreated SPB spots on the Bienville National Forest.

UNTREATED			
Spot No.	Additional SPB-caused tree mortality	Proliferation within 1/2 mile	Total additional volume loss CF (spot growth & proliferation)
1	0	3 spots	285
2	11	2 spots	295
3	6	0	126
			Avg. vol. loss per spot = 235 CF*

TREATED					
Spot No.	No. trees felled in buffer	Additional SPB-caused tree mortality	Proliferation within 1/2 mile	Additional volume loss to SPB CF	Total additional volume loss (incl. buffer) CF
4	14	0	0	0	133
5	22	0	0	0	462
6	19	0	0	0	181
7	20	0	1 spot	333	753
				Avg. vol. loss per spot = 383 CF*	

* No significant difference in the means of treatment vs. non-treatment at p = .10.

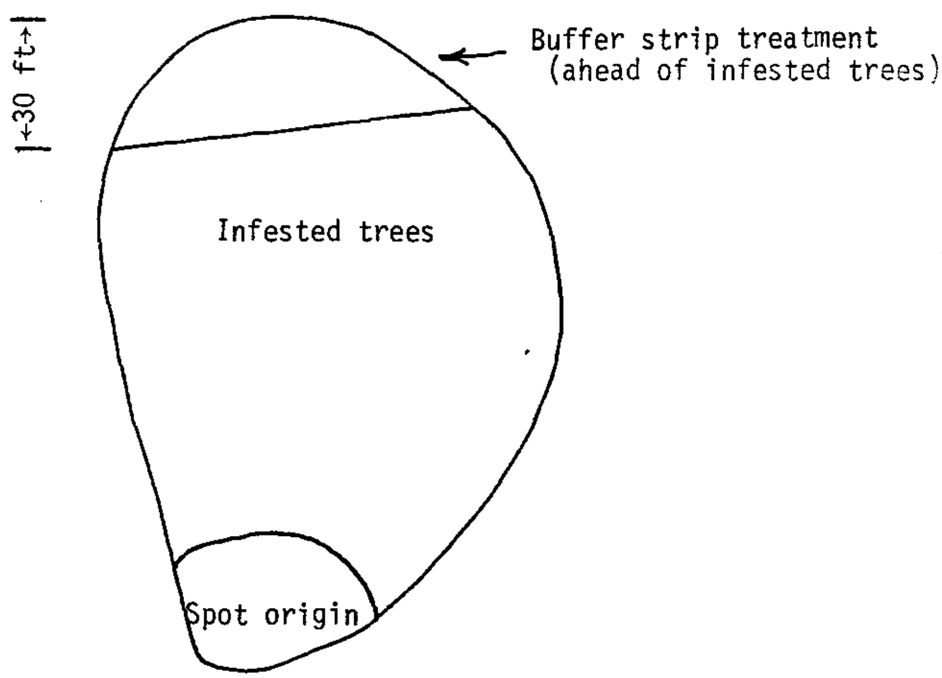

Fig. 1. SPB infestation showing area felled as buffer strip treatment.

Nearly all of the additional volume loss in the treated spots resulted from including volumes of trees felled in the buffer. This volume must be included in order to adequately assess treatment success.

Proliferation was greater around untreated spots. Volume lost from this new spot occurrence was also included in the comparison of volumes lost (Table 2). Though more new spots occurred around untreated spots, their volume loss was not enough to offset the volume loss through felling a buffer strip.

CONCLUSIONS AND RECOMMENDATIONS

1. This evaluation points out that a SPB spot disruption tactic, such as felling a buffer strip, can stop spot growth during the summer months. In addition, the treatment does not promote spot proliferation. Due to the lack of significant additional mortality in the untreated spots, it is not possible, however, to completely assess the value of felling a buffer strip.

2. Under the conditions of this evaluation (relatively small SPB spots) felling a buffer strip on a spot basis is not cost-effective. On the average, equal additional mortality occurred in both treated and untreated areas. This, however, emphasizes the fact that more effort is needed in understanding the dynamics of SPB infestation growth and decline, because all SPB infestations do not pose a threat in terms of significant additional volume loss.

   On an area basis, the value of disrupting spot growth may be more significant since the treatment appears to limit spot proliferation.

3. Further evaluation on the use of felling a buffer strip to reduce SPB-caused mortality should be pursued. Emphasis should be placed on larger SPB infestations.

   Disrupting spot growth can serve as a viable alternative to salvage removal or chemical treatment. Its application is relatively simple and non-labor intensive. Further investigation is therefore warranted.

ACKNOWLEDGEMENTS

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APPENDIX I

APPENDIX I

DETAILS OF COMPUTATION OF t-STATISTIC

	Spots 1 - 3	Spots 4 - 7
Mean	$\bar{X}_1 = 234.333$	$\bar{X}_2 = 382.250$
S.D.	$S_1 = 94.817$	$S_2 = 286.614$
N	$N_1 = 3$	$N_2 = 4$

Degrees of freedom = $N_1 + N_2 - 2 = 5$

Formula for t-statistic:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(N_1 - 1)S_1^2 + (N_2 - 1)S_2^2}{N_1 + N_2 - 2}} \sqrt{\frac{N_1 + N_2}{N_1 N_2}}} = .84$$

The hypothesis that the mean for spots 1 - 3 equals the mean for spots 4 - 7 would be rejected at the .10 level if the absolute value of the t-statistic equals or exceeds 2.571, the appropriate t-value with 5 degrees of freedom. Since the value of the t-statistic equals .84, the hypothesis is not rejected. There is no significant difference among the two means.